PRECISION

Standard of Accuracy

TEST EQUIPMENT

Radio – Television – Electrical – Industrial – Laboratory

Test Instruments manufactured to "Precision" standards of accuracy, workmanship and materials — products of an organization whose sole efforts are concentrated **exclusively** *in the development of the* **finest** *test equipment . . . nothing else!*

1948

PRECISION APPARATUS COMPANY, INC.

92-27 HORACE HARDING BLVD. • ELMHURST, NEW YORK

Export Division: 458 BROADWAY, NEW YORK CITY, U. S. A. • Cables: MORHANEX

An Understanding of "TEST SET ACCURACY"

There seems to be misunderstanding, on the part of some instrument users, as to the meaning of statements concerning instrument accuracy. It is hoped that the following will aid in clarification of the situation.

The **overall accuracy** of a test instrument is usually specified as the **arithmetic sum** of the individual contributing circuit component tolerances. Therefore, a 2% meter in conjunction with a 1% multiplier produces an instrument or test set of 3% **overall** tolerance or accuracy. Should a meter rectifier be also included in the circuit, the overall circuit tolerance is then that of the METER **plus** MULTIPLIER **plus** RECTIFIER.

This does not imply that every such test instrument is exactly of 3% or other specified overall tolerance. Laws of probability in normal selection of meters and multipliers can provide combinations of meters and multipliers which may, in part or total, negate the relative tolerances and thereby produce unusually close overall accuracy. This, however, **cannot** be specified as the **overall** tolerance of a production run, because it is just as probable for normal component combinations to run in non-cancelling direction.

The usual interpretation of overall accuracy, as applied to actual meter scaleplate readings is **"the specified overall tolerance, as of full scale."** This means that if a meter scale has 100 divisions, and if 3% overall instrument accuracy is specified, then the meter pointer may permissibly read plus or minus 3 divisions (.03x100) of the true value at any point on the scale.

In terms of a voltage or current range, (instead of just divisions), let us assume a full scale value of 600 volts. 3% of 600 volts is 18 volts. Therefore, when reading on a 600 volt range there is a potential and permissible error of plus or minus 18 volts. On a 60 volt range, the allowable error of 3% of 60 volts would be plus or minus 1.8 volts, etc.

Such permissible deviations must also be taken into consideration when making comparative readings between two or more instruments. The overall potential reading errors are arithmetically cumulative. Two units of plus or minus 3% overall accuracy may exhibit a total reading differential of 6% as compared to each other; whereas each individual instrument's reading would be within plus or minus 3% of the true voltage or current value.

Because of the non-linear nature of an ohmmeter scale, tolerance or allowable error on "OHMS" scales can best be related to linear scale length and not to actual resistance readings. Therefore, concerning ohmmeter ranges, if the instrument overall tolerance is 3%, the ohmmeter reading may potentially and permissibly vary plus or minus 3% of the total scale length, on either side of the true resistance value.

Other factors may also affect ohmmeter range accuracy; such as the degree of circuit alteration created by variation in resistance of the "Ohms Zero Adjust Control." The purpose of this control is to permit the resistance measuring circuit to operate with widest possible latitude in ohmmeter battery supply voltage.

"Precision" ohmmeter circuits employ special design features which provide for latitude in battery voltage with but negligible effect upon circuit accuracy. Therefore, "Precision" ohmmeter tolerances are essentially the same numerical order as specified for all other D.C. ranges.

* * *

Factors, such as temperature, may also affect the overall accuracy picture. Usually, these effects are sufficiently small, over normal temperate zone variations so as not to seriously disturb the initial specifications. The meter armature (moving coil), being copper-wound, is however, quite susceptible to resistance changes with temperature. In "Precision" test equipment, the meter "copper" is swamped by additional **manganin** wound resistance to minimize this source of error which would be common to the entire instrument circuit.

Compensating design considerations are also afforded to the A.C. meter-rectifier circuit to minimize temperature effects which might otherwise materially contribute to A.C. voltage reading inaccuracies.

* * *

"Precision" test sets employ only modern, rugged, double-bridge construction, D'Arsonval type meters of 2% accuracy or better. Wire wound shunts, calibrating resistors and matched metallized multipliers are produced to 1% tolerance or better. Overall D.C. instrument accuracy is accordingly maintained within ±3%; and A.C. circuit accuracy (including meter rectifier) is closely maintained within ±5%.

* * *

The foregoing is admittedly but a brief insight to the basic concepts surrounding instrument overall accuracy specifications. More detailed information appears in many radio and electrical texts and journals, as well as in "standards" literature published by many professional engineering institutes and societies.

THE PRECISION ONE YEAR WARRANTY

GUARANTEE

This is to certify that we, the PRECISION APPARATUS COMPANY, INC., Elmhurst, N. Y., U. S. A., guarantee this Instrument, manufactured by us, to be free from defects in material and workmanship under normal use and service. Our obligation under the guarantee is limited to repairing or replacing this instrument through the Service Department, Precision Apparatus Co., Inc., Elmhurst, N. Y., U. S. A., provided that it is returned **prepaid** within **one year** from date of sale.

This guarantee is expressly in lieu of all other guarantees, expressed or implied and of all other obligations on our part, and no other Representative or person is authorized or permitted to make any guarantee or to assume for this Company, any liability not strictly in accordance with the foregoing.

This guarantee will not apply to any product which has been tampered with or altered in any way, or which has been subjected to misuse, negligence or accident, or which has the serial number altered, effaced or removed.

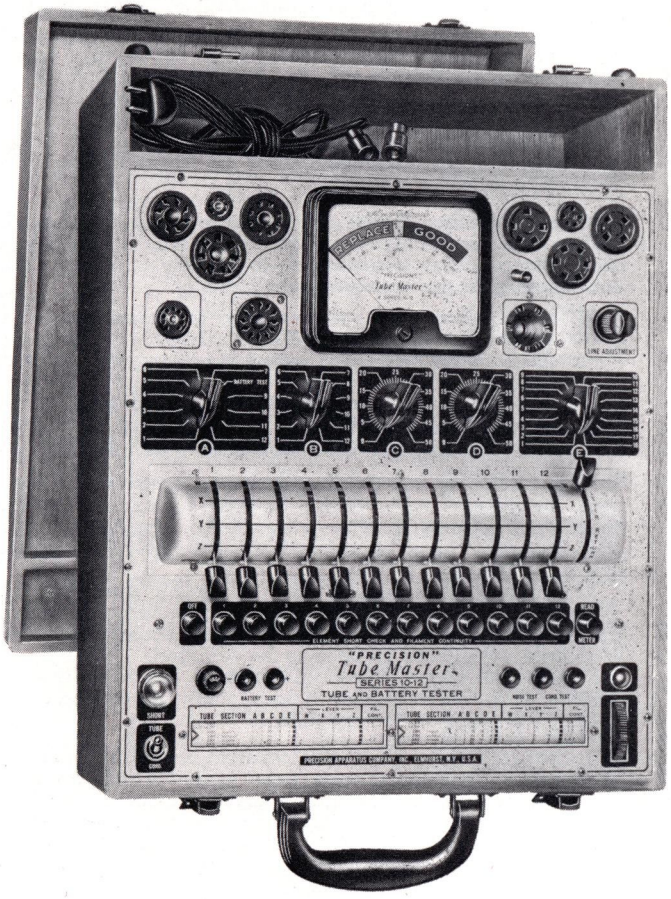
PRECISION APPARATUS CO., INC.
ELMHURST, N. Y., U. S. A.

PRECISION TEST EQUIPMENT IS GUARANTEED FOR ONE FULL YEAR!

PRECISION *Electronamic* Tube Master*

*REG. PEND. U. S. PATENT OFFICE

SERIES 10-12 TUBE AND BATTERY TESTER
THE NEW, TRULY FREE-POINT, MASTER ELECTRONAMIC TUBE PERFORMANCE TESTER
More than just Mutual Conductance. See pages 4 and 5 for details.



The new 10-00 Series of TUBE MASTERS and TEST MASTERS — represent the culmination of many years development of tube testing equipment to meet the exacting needs of the rapidly advancing field of electronics.

Incorporating the exclusive ELECTRONAMIC tube **performance** testing circuit, plus an advanced, "PRECISION" developed, multiple element, master lever selector system; it truly can be said that the MASTER 10-00 Series offers, to the **discriminating equipment purchaser,** the highest possible, practical order of test results and anti-obsolescence insurance.

Pages 4 and 5 provide the ""INSIDE STORY" of the ELECTRONAMIC circuit.

The Series 10-12 TUBE MASTER also provides direct facilities for battery, ballast and condenser testing, neon continuity checks and dual (low-high) short-check sensitivity test for special purpose tube selection; plus many special functional features of particular interest and value to commercial, industrial and communications fields of electronic tube applications.

Accommodates ALL FILAMENT VOLTAGE REQUIREMENTS to 117 volts including .75, 10, 18.9 and 85 volts. Tests the new NOVAL Button 9 pins; 5 and 7 pin Acorn types; dual capped H.F. tubes; Single-ended TV. and F.M. amplifiers; low power transmitting tubes; sub-miniatures; loktals; octals; button 7 pins; Bantam Juniors; etc. . . . REGARDLESS OF FILAMENT **OR ANY OTHER** ELEMENT **MULTIPLE PIN POSITIONS.**

PRECISION SERIES 10-12 TUBE MASTER
AVAILABLE IN FOLLOWING MODELS

☆ **10-12-P**—(Illustrated) In hardwood, tapered, portable case with tool compartment and hinged removable cover. Convenient for both portable and counter use. Size 13¾ x 17¼ x 6¾". Code: **Facil.**

☆ **10-12-C**—In modern, Chrome trimmed, counter cabinet; fine, dull black ripple finish on heavy gauge steel. Sizes 17 x 17⅞ x 7½". Slopes to 3" at front. Similar appearance as 912-C on page 9. Code: **Faith.**

☆ **10-12-PM**—Consists of 10-12 chassis, mounted onto matching steel panel with rear enclosing dust cover. Panel size 17½ x 19" for standard rack mount. Appearance similar to 912-PM on page 9. Code: **Favor.**

TUBE TESTING FEATURES

☆ **A TUBE "PERFORMANCE" TESTER:** employs the exclusive "Precision" engineered ELECTRONAMIC circuit, which ***in one operation,*** effectively, directly and simultaneously tests all tubes over a complete ***"Path of Operation"*** not just at one arbitrary operating point or for just one inconclusive characteristic. See technical details on pages 4 and 5.

☆ **TESTS ALL MODERN TUBE TYPES:** 17 individual filament supply voltages to 117 volts including .75, 10, 18.9 and 85 volts. Accommodates latest receiving tube basing systems including NOVAL Button 9 pin, 5 and 7 pin Acorn, dual-capped H.F. tubes, Single-ended TV. and F.M. amplifiers, low power transmitting tubes, sub-miniature types*, loktals, octals, Bantam Juniors, etc. . . . INCLUDING DIRECT FACILITIES UP TO TWELVE ELEMENT PRONGS!

*Uses specially engineered "Precision" G-110 universal sub-miniature "flexible lead" adapter. Accommodates the "proximity fuse" baseless style tubes regardless of varying lead length. Optional accessory.

☆ **ABSOLUTE FREE-POINT ELEMENT SELECTION:** Highest possible, practical order of insurance against obsolescence. A "Precision" engineered MASTER Lever Element Selector (with single action return) in combination with appropriately designed voltage and load selectors, ***locates every tube element*** regardless of position or frequency of appearance at the tube base; permitting direct application of each individual element test potential and load: control grid, screen, plate, etc. . . . ALL tube requirements met via a range of performance test potentials up to and including 300 volts.

☆ **ABSOLUTE, FREE-POINT, HOT, INTER-ELEMENT SHORT-CHECK SYSTEM** and Visible Filament Continuity Indicator: Through use of a single-purpose "Precision" engineered push-button selector (automatic-interlocking); positive, hot, inter-element short, leakage and filament continuity tests made uniformly and ingeniously simple for all tube types.

☆ **DUAL SHORT-CHECK-LEAKAGE TEST SENSITIVITY:** Sensitive, magnified neon lamp (lens protected) circuit quickly reveals poor cathode or other inter-element short-leakage conditions in accordance with tube manufacturers' specifications. At the flip of a switch, short-check sensitivity is doubled to permit ***special application*** tube selection to more rigid standards.

☆ **INDIVIDUAL TUBE SECTION TESTS:** Each section of multi-section tubes are ELECTRONAMICALLY tested as individual tubes ***without being removed from test socket.*** Tests gaseous rectifiers such as OZ3, OZ4, OA4, OY4, grid controlled relay tubes, etc. . . .

☆ **ELECTROSTATICALLY SHIELDED and BYPASSED** tube performance testing circuit for most accurate tests of very high mutual conductance TV. and F.M. amplifiers.

☆ **A.M. and F.M. CATHODE RAY TUNING INDICATORS** directly tested for fluorescent screen visibility and shadow action. Combination tuning indicator-amplifiers are doubly performance checked.

☆ **BALLAST UNIT TESTS:** The standard tube test sockets accommodate ballast units for continuity, loose element and inter-section leakage checks.

☆ **NOISE TEST** pin jacks provided on panel for direct earphone, speaker or amplifier connections.

☆ **MICRO-LINE ADJUSTMENT** read directly on meter. Uses a ***continuously variable*** line voltage control. No arbitrarily chosen transformer taps employed.

☆ **PILOT AND SIGNAL LIGHT TESTS** for miniature type lamps.

☆ **CONDENSER TEST** pin jacks provided on panel. Leakage tests paper condensers via same dual-sensitivity circuit employed for tube short-leakage testing.

☆ **ACCURACY** of tube test circuit closely maintained by use of individual, internal calibrating controls. Assures duplicate instrument performance against laboratory standards.

BATTERY TESTING FEATURES

☆ **TESTS RADIO A, B and C DRY BATTERIES** directly at only two polarized panel jacks.

☆ **A PRECISION ENGINEERED CIRCUIT** which ***performance*** checks each battery ***under actual load conditions.*** Battery quality read directly on a 3-color Replace-Weak-Good scale.

☆ **A SINGLE SELECTOR SWITCH** automatically selects the battery test voltage range ***and*** appropriate test load.

GENERAL "PRECISION" FEATURES

☆ **BUILT-IN, DOUBLE WINDOW, GEARED ROLLER TUBE CHART:** provides speedy tube test setting references. Cannot be mislaid or lost. New charts and supplements furnished FREE, upon request, for the life of the instrument.

☆ **PILOT LIGHT (ON-OFF) INDICATOR.**

☆ **FUSED POWER CIRCUIT:** panel-mounted extractor fuse post.

☆ **TEST CIRCUITS COMPLETELY INSULATED FROM POWER LINE.**

☆ **TELEPHONE-TYPE CABLED WIRING** using plastic-insulated, moisture resistant hook-up wire throughout.

☆ **4½" FULL VISION METER:** Rectangular, Bakelite cased. Rugged, double-jeweled, D'Arsonval construction, 2% accuracy.

☆ **WIRE WOUND CALIBRATING SHUNTS:** 1% accuracy.

PRECISION *Electronamic** TUBE TESTER

*Reg. Pend. U. S. Patent Office

PRINCIPLES OF ELECTRONAMIC TUBE TESTING

The All-Inclusive, Single-Operation, Positive Vacuum-Tube Performance Test!

More than just Mutual Conductance

☆ A most perplexing issue confronting the radio service engineer is the choice of tube testing equipment that will solve his tube test problems with **greatest possible accuracy and reliability.** With this thought foremost in mind, "PRECISION" engineers have devoted unlimited time in extensive vacuum tube testing research and development.

All varieties of tests were conducted upon thousands of tubes, at our own fully equipped laboratories **and** at the plants of leading tube manufacturers. From this, a vital point stood out above all others which dictated that **"the resultant tube tester design cannot be based upon just one selected characteristic, such as just mutual conductance alone.**

☆ A tube test based upon **just any one characteristic** does **not** fully vouchsafe the **overall** performance capabilities of an amplifying tube.

When a vacuum tube is "receiver tested", the electronic circuits DEMAND **PERFORMANCE** predicated upon the simultaneous presence and interaction of a multiplicity of tube characteristics including the following:

Electron Emission
Amplification Factor
Plate Resistance
Mutual Conductance (Transconductance)
Plate Current
Power Output, etc.

☆ To perform a whole series of such **individual** tests, in order to evaluate the overall merit of a tube, involves a collection of laboratory equipment hardly available to the general user of vacuum tubes. In addition, these characteristics are very closely knit to operating parameters. To the electronically trained mind, this means that the predictable characteristic values are dependent upon the great variety of voltage, current and load conditions to which the tube, under consideration, may be subjected. This further means that for ANY GIVEN TUBE TYPE, **there is not** just one value of mutual conductance or power output, etc. characteristic of that tube.

For this very reason tube characteristic manuals list CURVES (graphs) of operation to assist the design engineer in selecting tubes and circuit parameters which he **desires** to employ in the particular receiver or other electronic apparatus being developed.

The printed tubular data listed in tube manufacturers' manuals is not to be considered as fixed and inflexible ratings. Rather, such examples of operating conditions are given merely as guiding information. The tubes can be and are used under **any** suitable conditions within their maximum ratings. The **curves** provide the information to determine the proper operating points which will yield a required characteristic.

☆ One other aspect of the tube engineering problem is the question of rejection limits for any particular characteristic. This actually is a double-barrelled topic. New tube production is concerned with "Production Tolerance Limits." The electronic design engineer, and of course the apparatus which uses the tubes, are further interested in "Life Test End Limits."

Electronic apparatus, using vacuum tubes, must not only perform well with tubes which are within "Production Tolerance Limits," but should be able to perform until the tube has reached its "Life Test End Limit."

Detailed specifications of such "limits" are not generally available to the field and of course, specific **numerical** characteristics tests (such as micromhos) are inconclusive unless compared to a detailed table of limits parallelling actual test parameters or actual testing conditions.

Moreover, numerical characteristics readings (as micromhos) are not fully meaningful unless the tester **duplicates** the exact voltages and loads under which the particular tube in question is actually operating in the specific circuit from which it has been removed. It would furthermore require reference to the tube's plate family and transfer characteristic curves in order to determine what the numerical characteristic SHOULD be under the particular conditions in which the receiver is using this tube.

☆ Therefore, since the numerical value (such as micromhos) of a tube characteristic varies so widely with the applied element potentials, it is necessary to provide in TRUE vacuum tube characteristics **measuring** instruments:

1. Appropriate means for **metering** and reading each and every applied element potential.
2. Appropriate means for **metering** and reading each tube element current.
3. Suitable devices for **adjustment** and **control** of every element potential to duplicate operating conditions or to set up the specific operating point being investigated.

☆ It is obviously entirely impractical to construct such a device, for general tube testing, as would permit the operator to do this; not only from the viewpoint of simplicity of operation, but also in consideration of the extremely high cost and physical size.

Accordingly, such equipment (for actual **numerical** characteristics investigations) is only found in research and production laboratories, which are the only places wherein such elaborate equipment might ever be required.

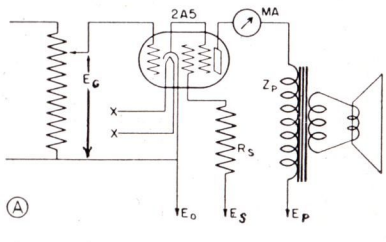
Needless to say, it would also not be practical for a tube tester's chart data to offer a multiplicity of alternative test settings for each and every tube.

☆ It has therefore been the constant purpose of Precision engineers to develop a tube tester circuit which would best meet the **realistic** needs of the electronic maintenance and radio service professions; to develop a basic test circuit affording the ultimate in correlation between test results and actual "in application" performance.

In the course of such investigations, it becomes conclusively apparent, that regardless of amplifier tube type number or variety of circuit applications, one phenomenon constantly manifests itself: **the tube output (voltage or power) is the result of a plate current caused by an applied control grid voltage, which current must be adequate even at full peak operating conditions.** This being a basic concept of amplifier tube operation (involving all operating characteristics), it led to the now famous, time-proven and tried, Precision "***Electronamic***" (Reg. Pend. U. S. Patent Office) tube tester.

☆ In offering the exclusive "***Electronamic***" tube tester, to the discriminating purchaser, Precision does so with a **"performance checked"** background. Such "performance" tests, particularly emphasized during World War II, were based upon the primary purpose of the instrument—**TO FIND BAD TUBES!**

☆ To familiarize ourselves with the principles of this exclusive "PRECISION" innovation, let us briefly observe the operation of a simple pentode such as the 2A5, in a standard power amplifier stage, shown in diagram A, with the addition of a current indicating meter in the plate circuit.



The primary purpose of this tube is to deliver electrical output to the speaker through plate load Zp, in the following

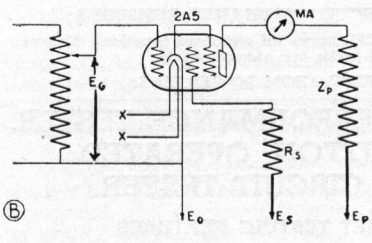
manner: with filament and plate supply operating and with zero signal applied to the input circuit, the plate milliammeter "MA" will indicate a steady current flow dependent upon cathode emissive power and the potentials of the interspaced elements. This zero signal meter reading is an indication of the tube's plate conductance. By applying an audio signal, Eg, to the input grid, THE PLATE CURRENT THROUGH Zp MUST VARY IN ACCORD WITH THE CHANGES IN GRID VOLTAGE. This is dependent upon the mutual conductance, plate resistance, amplification factor, load resistance, etc. The greater the grid voltage swing, the greater should be the plate current excursions, and accordingly, the louder the sound from the speaker.

Let us now assume that a high order of peak grid signal voltage is applied, that is in keeping with the tube operating conditions, but severe distortion is nevertheless produced at the speaker, even though all circuit components, aside from the tube, are normal. This condition coincides with low peak plate current readings, and is usually caused by poor cathode structure and/or high plate resistance. In other words, an insufficient quantity of electrons is available to the plate circuit to handle peak power requirements.

Now let us suppose that with a normal signal applied to the input circuit, insufficient or no volume is obtained from the speaker, again assuming all circuit components, aside from the tube, are normal. This condition would indicate that the magnitude of plate current variations versus applied grid signal are not in keeping with the tube specifications and circuit requirements. This can be caused by a multiplicity of internal tube conditions, including reduced amplification factor, low mutual conductance, open, misplaced or shorted screen, control grid, suppressor, or plate, even though the tube's cathode structure may be absolutely normal.

In the case of resistance-coupled amplifiers, the change in plate current produces a change in voltage drop across the plate load resistor. This is then passed on through suitable coupling means to the succeeding stage.

☆ It can therefore again be readily seen that the overall PERFORMANCE Merit of a tube is absolutely dependent on the ability of **output plate current to respond to the applied grid voltage, over the full range of possible operating conditions, which involves More than just Mutual Conductance.**



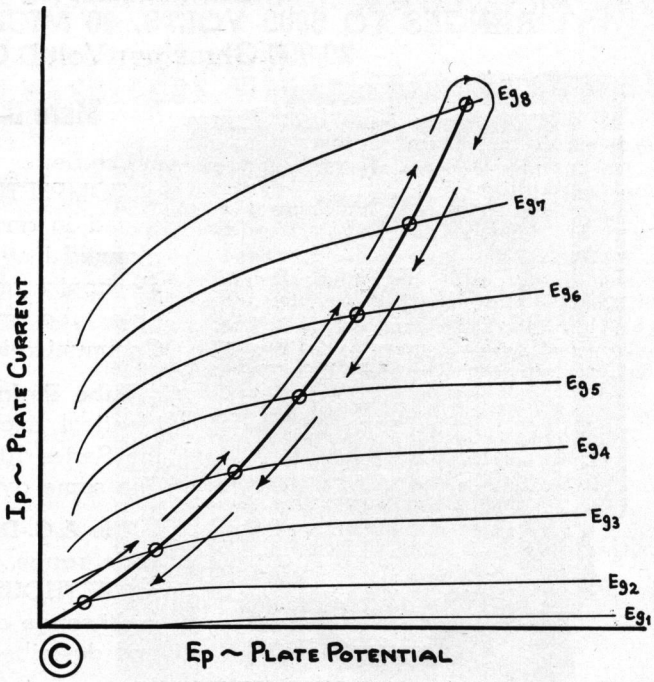
In Diagram B is shown the PRECISION "*Electronamic*" circuit set up to check the same type 2A5. Note that individual plate, screen and grid voltages and loads are applied to the respective elements of the tube under test and **it is thereby being "*Electronamic*ally"** tested as a pentode. PLATE SUPPLY VOLTAGES FROM 50 TO AS HIGH AS 300 VOLTS ARE APPLIED TO THE TUBES UNDER TEST DEPENDING ON THE INDIVIDUAL TUBE'S REQUIREMENTS.

Appropriate treatment is accorded all amplifier tubes depending whether they are triodes, tetrodes, etc. Multi-purpose tubes are treated and tested as two or more completely independent tubes, WITHOUT REMOVING THE TUBE FROM THE TEST SOCKET. All plate, screen, grid and filament test voltages and respective loads are factory calibrated (per the roller chart) to assure the high tube performance correlation for which the "*Electronamic*" tube testers are known to the field, both civilian and the military — a performance check based upon the **peak service** for which the tube was designed rather than just an arbitrarily chosen low or midpoint.

☆ As previously outlined, the overall quality or performance merit of a tube is dependent on how well control grid voltage "controls" plate current over a complete **range** of tube application.

For this reason, the PRECISION "*Electronamic*" circuit places the TUBE MERIT METER in the plate or output section only of the tubes under test, and accordingly, the resultant quality or performance figure of merit involving a whole **series** of meaningful operational factors, not just one inconclusive characteristic, and will reject all tubes which do not come up to the same standards from which the tube chart data is prepared.

☆ Much of the success of the "*Electronamic*" tube tester is attributable to the ELECTRO-DYNAMIC SWEEP nature of its circuit operation. Through application of appropriately phased individual element potentials, the tube under test is dynamically swept over a **Path of Operation,** on a sinusoidal time base, encompassing a wide range of plate family characteristics curves. In brief, the tube under test is made to **perform** on a basis which involves its ability to operate at a multiplicity of



potential peak conditions rather than at just one arbitrarily chosen point.

Reference to diagram C graphically and directly illustrates this "*Electronamic*" picture. It is this encompassing **Path of Operation, involving More than just Mutual Conductance,** which is automatically integrated by the meter as the resultant figure of merit in the direct and non-confusing terms of REPLACE-WEAK-GOOD.

☆ The very nature of the "*Electronamic*" circuit necessitates and assures utmost instrument flexibility, to permit positive location and selection of all tube elements. In the "900" Series, this is accomplished via appropriate combination of a multi-purpose PUSH-BUTTON master element selector system plus simplified load-potential rotary switch design. In the "10-00" MASTER series, the "*Electronamic*" facilities are further magnified via design and use of a new LEVER TYPE master element selector system in combination with a multiple push-button short check unit, plus specially engineered rotary, load and element potential selectors.

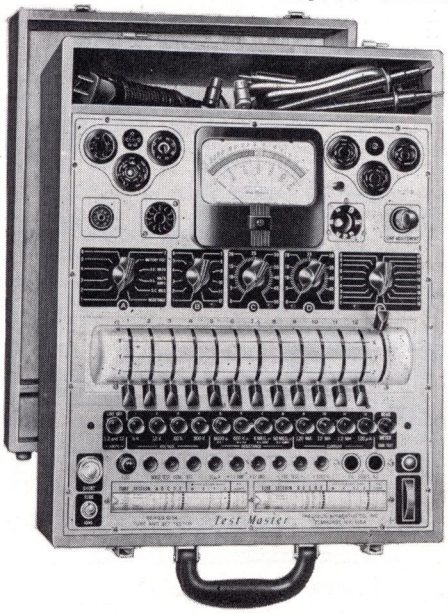
☆ **Aside from** the development of this exclusive "*Electronamic*" circuit, full consideration was given to the design of a Hot Cathode Leakage test, inter-element Short Check, instantaneous Filament Continuity Test and Audible Noise Test, affording maximum reliability and accurate neon lamp indications to show up physical and mechanical tube defects such as cathode to filament leakage, shorted, loose or open elements, open filaments, etc. THE CATHODE LEAKAGE CIRCUIT SENSITIVITY IS ADJUSTED TO COMPLY WITH THE APPROVED LEAKAGE SPECIFICATIONS OF LEADING TUBE MANUFACTURERS. Additional independent circuit facilities appropriately accommodate all diodes, rectifiers, tuning eyes, gas rectifiers, thyratrons, etc.

☆ Modern methods of construction, telephone cabled wiring, Precision resistors and wire-wound impregnated shunts, and highest quality of materials combined with INDIVIDUAL DUAL CALIBRATION against laboratory standards, insures maximum accuracy and ruggedness for lasting satisfaction. NEW TUBE TEST DATA CHARTS ARE FURNISHED UPON REQUEST FROM TIME TO TIME AT ABSOLUTELY NO CHARGE — FOR THE LIFE OF YOUR "PRECISION" TUBE CHECKER.

PRECISION *Electronamic** *Test Masters* SERIES 10-54 SERIES 10-20

*Reg. Pend. U. S. Patent Office

SERIES 10-54 COMBINATION MASTER ELECTRONAMIC TUBE PERFORMANCE TESTER, BATTERY TESTER, AND 35 RANGE, PUSH-BUTTON OPERATED, SUPERSENSITIVE, A.C.-D.C. SET TESTER
RANGES TO 6000 VOLTS, 60 MICROAMPS, 12 AMPS, +70DB, 60 MEG.
20,000 Ohms per Volt D.C.—1000 Ohms per Volt A.C.



More than just Mutual Conductance (Technical details on pages 4 and 5)

The Series 10-54 affords, **to the discriminating instrument purchaser,** a COMPLETE, PORTABLE service laboratory; engineered and produced in answer to the ever increasing demand for practical, well planned instrumentation to meet the rapidly developing needs of the electronics art; provides every necessary facility for high speed, reliable tube and circuit testing associated with Industrial, Electronics, Communications, Radio (A.M.-F.M.), Television, Laboratory, etc. . . .

Tube Performance Testing features: Series 10-54 incorporates the identical, exclusively Precision, ELECTRONAMIC circuit described for the Series 10-12 on page 3 and Circuit Principles on pages 4 and 5. The same dynamic Battery Testing circuit is also provided.

The A.C.-D.C. Multi-Range Set Testing Circuit provides a complete, wide range, high-speed, **push-button operated, super-sensitive** test set WITHOUT ANY ADDITIONAL PANEL CONTROLS. The MASTER multi-range circuit incorporates all of the rigid standards applying to and described for the Series 858 MULTI-MASTER on page 11.

CIRCUIT TESTING FEATURES

☆ SIX D.C. VOLTAGE RANGES at 20,000 ohms per volt:
0-6—12—60—300—1200—6000 volts

☆ SIX A.C. VOLTAGE RANGES at 1000 ohms per volt:
0-6—12—60—300—1200—6000 volts

☆ SEVEN D.C. CURRENT RANGES:
0-60—120 microamperes
0-1.2—12—120—1200 MA. and 0-12 amperes

☆ FOUR SELF-CONTAINED RESISTANCE RANGES: no A.C. required.
0-6000—600,000 ohms; 0-6—60 megohms

☆ SIX DECIBEL RANGES from —20 to +70 DB.

☆ SIX OUTPUT RANGES. Same as A.C. volts ranges.

☆ AUTOMATIC INTERLOCKING PUSH-BUTTON range selection.

☆ 4⅝" WIDE VISION METER: 50 microamperes sensitivity. Rugged, double-bridge, D'Arsonval type construction. Alnico V field magnet.

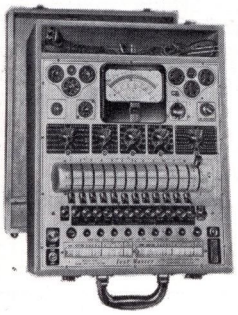
☆ 1% WIREWOUND AND MATCHED METALLIZED RESISTORS.

☆ ONLY 2 POLARIZED TIP JACKS serve all standard functions. Extreme ranges at separately identified jacks for utmost safety.

☆ ALL TEST CIRCUITS INSULATED FROM POWER LINE.

SERIES 10-20 COMBINATION MASTER ELECTRONAMIC TUBE PERFORMANCE TESTER, BATTERY TESTER AND 34 RANGE A.C.-D.C. PUSH-BUTTON OPERATED 1000 OHMS PER VOLT A.C. and D.C. CIRCUIT TESTER

More than just Mutual Conductance



A complete, rugged service laboratory incorporating the exclusive "PRECISION" ELECTRONAMIC Tube Performance Tester, combined with full 1000 ohms per volt A.C. and D.C. Multi-Range features; plus a complete radio A, B and C Battery Tester.

Ideally suited and particularly engineered for general purpose radio-electronic maintenance, service and installation.

The Series 10-20 TEST-MASTER provides the identical tube and battery testing features as outlined for the Series 10-12 on page 3 and "Circuit Principles" on pages 4 and 5.

The wide range, high speed, push-button operated MASTER set testing functions provide ranges to: 3000 volts, 600 microamperes, 12 amperes, 10 megohms, +70 DB ALL SELF CONTAINED AND WITHOUT ANY ADDITIONAL PANEL CONTROLS. The same high Precision standards of workmanship, quality and performance outlined for the Series 10-54 apply equally to the Series 10-20.

SET TESTING FEATURES

☆ SIX A.C. AND SIX D.C. VOLTAGE RANGES:
0-6—12—60—300—1200—3000 volts

☆ SIX D.C. CURRENT RANGES:
0-600 microamperes
0-6—60—300—1200 MA. and 0-12 amperes

☆ FOUR SELF-CONTAINED RESISTANCE RANGES: No A.C. power required.
0-1000—100,000 ohms; 0-1—10 megohms

☆ SIX DECIBEL RANGES from —20 to +64 DB.

☆ SIX OUTPUT RANGES: Same as A.C. volts.

☆ 4⅝" WIDE VISION METER: 400 microampere ±2%, rugged, double-bridge, D'Arsonval type movement. Alnico II field magnet.

☆ 1% WIREWOUND AND MATCHED METALLIZED RESISTORS.

☆ 2 POLARIZED TIP JACKS serve all standard ranges.

☆ AUTOMATIC INTERLOCKING PUSH-BUTTON RANGE SELECTION.

☆ ALL CIRCUITS INSULATED FROM POWER LINE.

PRECISION SERIES 10-54 AND 10-20 AVAILABLE IN FOLLOWING MODELS

PORTABLE

☆ **10-54-P** (illustrated)—Code: **Habit**

☆ **10-20-P** (illustrated)—Code: **Daily**

In hardwood, tapered, portable case with tool compartment and hinged removable cover. Convenient for both portable and counter use. Size 13¾ x 17¼ x 6¾". Complete with test leads* and ohmmeter batteries.

COUNTER

☆ **10-54-C**—Code: **Handy**

☆ **10-20-C**—Code: **Dance**

In modern, chrome trimmed, rounded counter type cabinet; fine, dull black ripple finish on heavy gauge steel. Size 17 x 17⅞ x 7½". Slopes to 3" at front. Similar in appearance to 912-C cabinet on page 9. Complete with test leads* and ohmmeter batteries.

PANEL MOUNT

☆ **10-54-PM**—Code: **Harem**

☆ **10-20-PM**—Code: **Dandy**

Mounted onto 17½ x 19" steel panel with rear enclosing dust cover. For standard Rack mount. Appearance similar to 912-PM on page 9. Furnished complete with test leads* and ohmmeter batteries.

***Extra-high voltage test leads** are standard with all Series 10-54 models.

PRECISION DE LUXE *Electronamic** INSTRUMENTS

SERIES 10-15

Tube Master

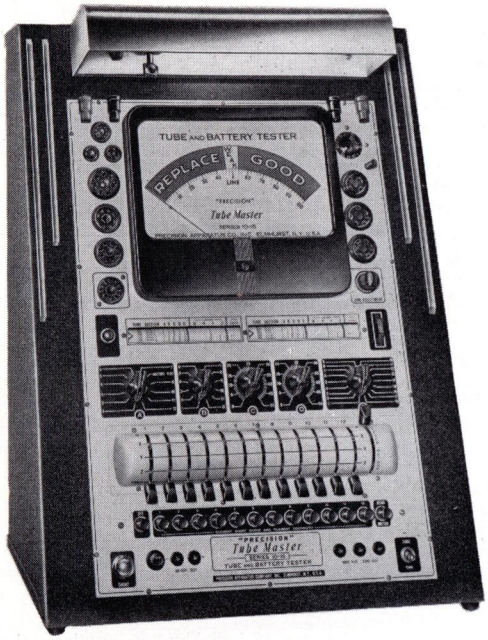
More than just Mutual Conductance

(Technical details on pages 4 and 5)

SERIES 10-22

Test Master

ULTRA-MODERN, ATTRACTIVE TUBE MERCHANDISERS WITH LARGE 9" METERS



☆ **10-15 TUBE AND BATTERY MERCHANDISER.** Impressively cased in heavy gauge steel cabinet. Finished in fine, dull black ripple, with chrome trim and chrome finished meter lamp reflector fixture. Size is 24 inches high, 17½ wide, with a base depth of 10 inches tapering to 4 inches at the top. Complete with operating instructions. Code: **Gable.**

☆ Incorporates the **identical,** "Precision" engineered, exclusive ELECTRONAMIC tube performance and battery testing circuit and electrical features described for Series 10-12 on page 3 and Circuit Principles on pages 4 and 5.

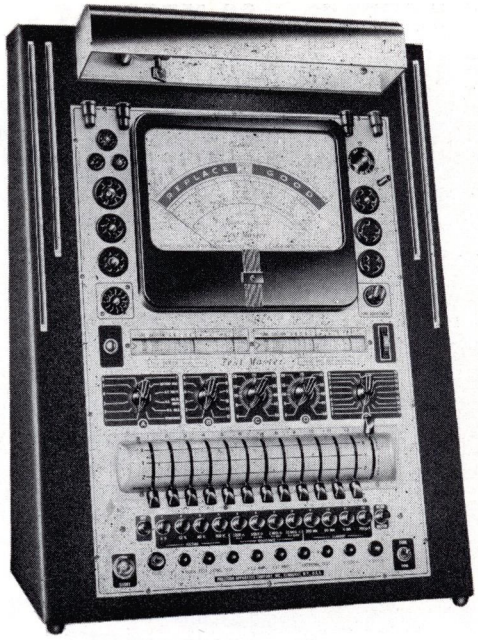
☆ Designed particularly for the discriminating, equipment conscious, progressive radio service-sales organization, and tube-selling sections of department stores.

☆ PROMOTE CUSTOMER CONFIDENCE and INCREASE TUBE SALES via this eye-appealing, impressive Precision Tube Merchandiser.

☆ 9" RECTANGULAR BAKELITE CASED METER.

☆ DIRECT READING—NON CONFUSING TUBE PERFORMANCE INDICATIONS in large, easy reading terms of Replace-Weak-Good.

☆ ILLUMINATED by built-in, large chromium reflector fixture.



☆ **10-22 COMBINATION TUBE AND BATTERY MERCHANDISER plus A.C.-D.C. MULTI-RANGE SET TESTER.** In same attractive finish and cabinet as described for the model 10-15 (at left). Complete with operating instructions, test leads and ohmmeter batteries. Code: **Gauge.**

☆ The Series 10-22 DeLuxe ELECTRONAMIC **Service Laboratory** is **electrically identical** to the Series 10-20 described on page 6.

☆ Incorporates every customer inspiring and sales promotional advantage of the Series 10-15, at left, plus a complete, rugged 34 range A.C.-D.C. push-button operated, Multi-Range Test Set.

☆ TUBE AND SERVICE FACILITIES are brought to the foreground with this modern, impressive Precision engineered instrument.

*Reg. Pend. U. S. Patent Office

SERIES 10-15 and 10-22 ALSO AVAILABLE IN STANDARD PANEL MOUNT

☆ **10-15-PM** Code: **Gavot.**

☆ **10-22-PM** Code: **Gamut.**

Attractively mounted on heavy gauge steel panel with rear enclosing dust cover. Panel size 22¾ x 19" for standard rack mount. Fine, dull black ripple finish. Ideal for behind the counter flush instrument display; also admirably suited for insertion into the center of tube stock-display shelving.

PRECISION *Electronamic** SERIES 954

*Registration Pending U. S. Patent Office

Combination ELECTRONAMIC Tube Tester, Battery Tester and 37 Range Super-sensitive A.C.-D.C. Multi-range Set Tester

20,000 OHMS PER VOLT D.C.

Ranges to 6000 VOLTS A.C.-D.C. • 60 MICROAMPERES • 12 AMPERES • 60 MEGOHMS • +70 DB.

More than just Mutual Conductance

(See details on pages 4 and 5)

A complete supersensitive service laboratory incorporating **the** "PRECISION" developed and engineered **"Electronamic"** tube tester, combined with full A.C. and D.C. Multi-Range features; also provides for ballast unit tests, condenser testing, neon continuity facilities plus a complete radio A, B and C battery tester.

The **"Electronamic"** tube test circuit accommodates ALL FILAMENT VOLTAGE REQUIREMENTS from 1.4 through 120 volts. Tests all new Loktals, Octals, Bantam Octals, Single-ended, Television and F.M. amplifiers, Bantam Junior, Button 7 pin and the new Button 9 pin tubes.

The Battery Testing circuit DIRECTLY accommodates ALL POPULAR portable-radio A, B and C batteries, from 1.5 through 135 volts.

The supersensitive set testing circuit provides 37 RANGES FOR:
A.C. and D.C. VOLTAGE MEASUREMENTS TO 6000 VOLTS.
D.C. CURRENT MEASUREMENTS TO 12 AMPERES.
RESISTANCE MEASUREMENTS TO 60 MEGOHMS.
DECIBEL READINGS TO +70 DB.

PRECISON ELECTRONAMIC SERIES 954

AVAILABLE IN FOLLOWING MODELS

☆ **954-P** (illustrated)—In hardwood, portable case with tool compartment and hinged removable cover. Size 12 x 13 x 6". Complete with battery, test leads and operating instructions. Code: **Happy.**

☆ **954-MCP**—Open type Metal Case Portable, black ripple finish as illustrated for Series 912-MCP on page 9. Size 10½ x 12 x 6". Complete as above. Code: **Horse.**

☆ **954-PM**—Consists of Series 954 chassis mounted onto matching steel panel and dust cover. Panel size 12¼ x 19" for standard rack mount. Appearance same as illustrated for Series 912-PM on page 9. Code: **Hermit.**

☆ **954-C**—In modern, chrome trimmed, round edge, counter type cabinet; black ripple finish on heavy gauge steel. Size 16 x 13½ x 7". Slopes to 3 inches at front, as illustrated for 912-C on page 9. Complete, ready to operate. Code: **Human.**

TUBE AND BATTERY ANALYZING FEATURES

☆ Features the exclusive "PRECISION" engineered "Electronamic" circuit, which in one operation, "performance" tests all radio receiving tubes. See technical details on pages 4 and 5.

☆ TESTS ALL TUBE TYPES: Filament voltages from 1.4 to 120 volts —Loktals, Bantam Junior and Button 7 and Button 9 Pin miniature tubes, Single-ended, Television and F.M. Amplifiers, Regular Octals (MG, G, GT and metals), Spray-Shield and Glass types.

☆ TESTS ALL PORTABLE RADIO DRY BATTERIES: Using only 2 pin jacks, this "Precision" engineered circuit DIRECTLY accommodates ALL popular radio A, B and C batteries 1.5 to 135 volts UNDER ACTUAL LOAD CONDITIONS and reads on simple REPLACE —WEAK—GOOD scale. A single selector switch automatically applies appropriate load for the particular battery under test.

☆ AUTOMATIC PUSH BUTTON SYSTEM: High flexibility for free-point tube analysis of present and future tube releases.

☆ DUAL FREE-POINT FILAMENT TERMINAL SELECTION. VISIBLE FILAMENT CONTINUITY TESTS.

☆ SPECIFIC INDIVIDUAL LOADS AND VOLTAGES: (Control Grid, Screen, Plate, etc.) APPLIED TO EACH ELEMENT OF TUBE UNDER TEST. Variable supply voltages, up to 300 volts, satisfy all tube requirements.

☆ PREDETERMINED A.C. SIGNAL applied to control grids.

☆ METER READS IN PLATE CIRCUIT ONLY: The "Electronamic" Circuit indications entirely dependent upon control action of each of the intervening elements. Meter indication shows up any tube having an open element.

☆ TESTS all single and multi-section tubes, gas types, visible tests of the cathode ray indicator tubes, etc.

☆ HOT CATHODE LEAKAGE TEST: Sensitive neon method in accord with leakage specifications of tube manufacturers.

☆ HOT INTER-ELEMENT SHORT TESTS through the "PRECISION" Automatic Interlocking Push Button System.

☆ NOISE TEST pin jacks for earphone or amplifier connection.

☆ BALLAST TESTS: Accommodates ballast units for open, loose elements and leakage between section tests.

☆ MICRO-LINE ADJUSTMENT read directly on meter.

☆ PILOT-LIGHT TESTS for all miniature type lamps.

☆ BUILT-IN DOUBLE-WINDOW ROLLER TUBE CHARTS. New charts furnished at no charge.

☆ PILOT LIGHT (ON-OFF) INDICATOR: DUAL FUSED LINE PLUG.

☆ TELEPHONE CABLED, PLASTIC INSULATED WIRING.

☆ ACCURACY of the exclusive "Electronamic" tube test circuit closely maintained by use of individual calibrating controls, adjusted and sealed against laboratory standards.

SET ANALYZING FEATURES

☆ Seven D.C. voltage ranges at 20,000 ohms per volt.
0-3-12-60-300-600-1200-6000 VOLTS!

☆ Seven A.C. voltage ranges at 1000 ohms per volt.
0-3-12-60-300-600-1200-6000 VOLTS!

☆ Seven D.C. current ranges.
0-60-300 Microamperes.
0-3-30-120-600 Milliamperes.
0-12 AMPERES.

☆ Three Resistance Ranges: powered by self-contained supply.
0-6000 ohms (35 ohms at center scale)
0-600,000 ohms, 0-60 MEGOHMS.

☆ Six Decibel Ranges from —12 to +70 DB.

☆ Seven Output Ranges.
0-3-12-60-300-600-1200-6000 VOLTS!

☆ MASTER RANGE SELECTOR SYSTEM: Permits simplified speedy measurements and rapid selection of all ranges.

☆ LARGE 4⅝" MODERN "PRECISION" SQUARE TYPE METER: 50 microamperes full scale sensitivity, 2% accuracy. Ruggedly constructed to withstand rough handling.

☆ WIRE-WOUND SHUNTS and matched metallized multipliers, 1% accuracy.

☆ LARGE EASY READING SCALES AND NUMERALS.

☆ CONDENSER LEAKAGE TESTS.

☆ ACCURACY of A.C. voltage and decibel ranges is closely maintained through two individual calibrating controls, adjusted and sealed against laboratory standards.

PRECISION *Electronamic* SERIES 920

Combination tube, battery and set tester similar to Series 954 above except standard 1000 ohms per volt A.C. and D.C. sensitivity, and ranges to 3000 volts, 10 megohms and +64 DB.

Furnished in same types as listed for 954.

*920-P	Code: Drive
*920-MCP	Code: Dicer
*920-PM	Code: Dream
*920-C	Code: Drake

PRECISION

DE LUXE *Electronamic** TUBE TESTER

More than just Mutual Conductance

(See details on pages 4 and 5)

☆ **915 TUBE AND BATTERY MERCHANDISER** — Attractively finished in black ripple with chromium trim and chromium meter lamp reflector. Case of heavy gauge steel. Size 23 inches high, 16 inches wide. Bottom depth 10 inches and tapers to 4 inches at top. Code: **Grace.**

☆ Inspire Customer Confidence!

☆ Increase Tube Sales with this new modern impressive Precision Tube Merchandiser!

☆ Large 9" SQUARE TYPE BAKELITE CASED METER.

☆ EASY READING 3 colored Replace—Weak—Good scale.

☆ Full Vision Dual-Window Roller Tube Chart.

☆ Instrument Panel illuminated by large Chromium Reflector.

☆ Precision "Electronamic" test circuit insures accurate and reliable tube testing results.

☆ Electrical features exactly the same as "Tube and Battery Analyzing" features described for Series 954 on page 8; and technical details on pages 4 and 5.

PRECISION

*Electronamic** TUBE and BATTERY TESTER SERIES 912

More than just Mutual Conductance

(See details on pages 4 and 5)

☆ **Series 912-P**

The 912 Series, "Electronamic" tube and battery testers incorporate an impressive, wide faced, 4⅝" bakelite cased meter with D'Arsonval type movement of 2% accuracy. The tube analyzing and radio battery testing features are the same as those described for the Series 954 under the heading, "Tube and Battery Analyzing Features" on page 8 and Circuit Principles described on pages 4 and 5.

PRECISION SERIES 912 AVAILABLE IN FOLLOWING MODELS

☆ **912-P**—(illustrated above) In hardwood, walnut finished portable case with tool compartment and hinged removable cover. Size 12 x 13 x 6". Complete with operating instructions. Code: **Fence.**

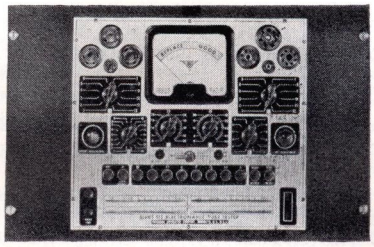
☆ **912-MCP**—Open type Metal Case Portable, black ripple finish, as illustrated below. Size 10½ x 12 x 6". Complete, ready to operate. Code: **Felon.**

☆ **912-C**—In modern, chrome trimmed, round edge counter type cabinet. Black ripple finish on heavy gauge steel. Size 16 x 13½ x 7". Slopes to 3" at front. Complete, as illustrated below. Code: **Frame.**

☆ **912-PM**—Consists of Series 912 chassis mounted onto matching steel panel and dust cover. Panel size 12¼ x 19", for standard rack mount. See illustration below. Code: **Fetid.**

☆ 912-MCP

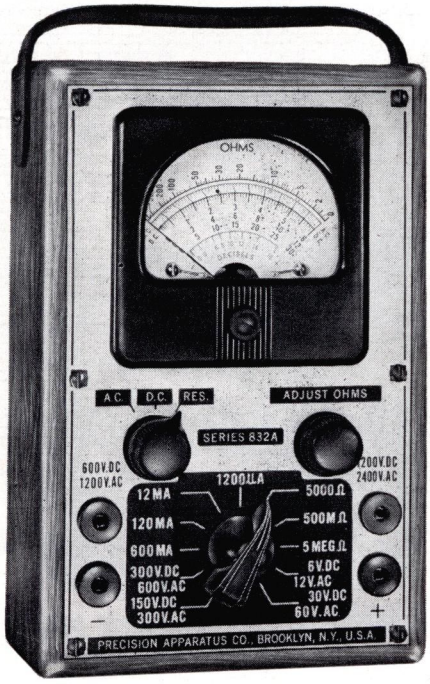
☆ 912-C



☆ 912-PM

PRECISION SERIES 832-S

31 Range COMPACT A.C.-D.C. MULTI-RANGE Tester with full sized 3" square Bakelite cased meter Ranges to 1200 VOLTS D.C. • 2400 VOLTS A.C. 5 MEGOHMS • 600 MA and +62 DB.



Though small in size, the Series 832-S incorporates specialized constructional features so as to make use of the same full-bodied electrical components provided in all larger size "Precision" multi-range test instruments. Meter scale plate design has been carried through in Black, Red and White with large sized numerals, for maximum visibility and ease of reading.

The Series 832-S is an ideal PRECISION instrument built to withstand abuse and rough handling in services to which compact instruments are routinely applied, as in radio service, amateur radio, trouble shooting, etc.

SPECIFICATIONS

☆ **Six D.C. Voltage Ranges at 1000 ohms per volt:**
0-6; 0-30; 0-150; 0-300; 0-600; 0-1200 volts

☆ **Six A.C. Voltage Ranges at 500 ohms per volt:**
0-12; 0-60; 0-300; 0-600; 0-1200; 0-2400 volts

☆ **Four D.C. Current Ranges:**
0-1.2; 0-12; 0-120; 0-600 milliamperes

☆ **Three Resistance Ranges:**
0-5000 ohms (20 ohms at center of scale)
0-500,000 ohms—all on internal battery
0-5 MEGS—powered by external battery

☆ **Six Decibel Ranges from —10 to +62 DB.**

☆ **Six Output Ranges:**
0-12-60-300-600-1200-2400 volts

☆ **Wide Faced, 2% accuracy, 3" bakelite-cased 800 Microampere Meter.**

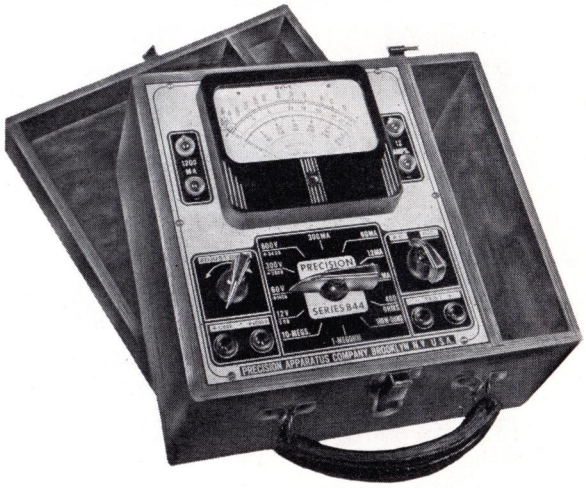
☆ **Wire-Wound shunts and matched metallized multipliers of 1% accuracy.**

☆ **Individually sealed calibrating controls and wax impregnated telephone cabled wiring as on all "PRECISION" built instruments.**

Series 832-S—(illustrated) Furnished in hardwood walnut finished case (7 x 4½ x 3") with leather handle, complete with internal batteries and test leads. Code: **Anvil:**

PRECISION SERIES 844

34 Range LABORATORY STYLE A.C.-D.C. TEST SET • Full Vision 4⅝" Rectangular Meter. Self-Contained Ranges to 6000 VOLTS A.C. and D.C., 10 MEGOHMS • 12 AMPS, +70 DB.



The Series 844, 4⅝ metered, standard sensitivity, general utility A.C.-D.C., multi-range test set has been specifically designed and constructed for constant usage and rough handling as imposed by the Radio serviceman, engineer, amateur, laboratory and industrial.

The extra large, 4⅝ rectangular, 400 microampere 2% accuracy, D'Arsonval type meter affords utmost scale length, visibility and ease of reading.

1% wirewound and matched metallized multipliers.

Simplified Rotary Range and Function Selection allows all standard A.C.-D.C. measurements to be made from only two tip jacks.

Features all the "Precision" standards of materials, workmanship, quality, performance and accuracy.

SPECIFICATIONS

☆ **SIX A.C. VOLTAGE RANGES at 1000 ohms per volt:**
0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ **SIX D.C. VOLTAGE RANGES at 1000 ohms per volt:**
0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ **SIX D.C. CURRENT RANGES:**
0-1.2; 0-12; 0-60; 0-300; 0-1200 MA; and 0-12 Amperes.

☆ **FOUR RESISTANCE RANGES (self contained batteries):**
0-400; 0-100,000; 0-1 Meg.; and 0-10 Megs.

☆ **SIX DECIBEL RANGES from —12 to +70 DB.**

☆ **SIX OUTPUT RANGES:**
0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ **844-L**—In modern, shallow, lab. style, Bakelite case with leather carrying handle. Size 7⅜ x 8⅜ x 3". Complete with operating instructions, batteries and test leads. Code: **Manse.**

☆ **844-P** (illustrated) — In hardwood, portable case, with tool compartment and hinged removable cover. Size 9 x 10 x 6". Complete with all instructions, batteries and test leads. Code: **Malad.**

PRECISION SERIES 858 DUAL-RANGE SENSITIVITY SUPER SENSITIVE *Multi-Master*

PUSH BUTTON OPERATED, HIGH SPEED, A.C.-D.C. MULTI-RANGE TEST SET

54 Ranges to 6,000 Volts, 60 Microamperes, 12 Amperes, 600 Megohms, +70 DB. for Television, Radio (A.M. and F.M.), Industrial, School and Laboratory Application

20,000 OHMS per Volt D.C.

1000 ohms per volt D.C. • 1000 ohms per volt A.C.

SPECIFICATIONS

☆ EIGHT D.C. VOLTAGE RANGES at 20,000 ohms per volt:
0-3; 0-6; 0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ EIGHT D.C. VOLTAGE RANGES at 1000 ohms per volt:
0-3; 0-6; 0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ EIGHT A.C. VOLTAGE RANGES at 1000 ohms per volt:
0-3; 0-6; 0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ EIGHT D.C. CURRENT RANGES:
0-60; 0-120 microamperes
0-1.2; 0-12; 0-120; 0-600 MA; and 0-1.2; 0-12 Amps.

☆ SIX RESISTANCE RANGES: self-contained to 60 megohms:
0-6000 ohms (35 ohms at center scale)
0-60,000; 0-600,000 ohms; 0-6; 0-60 megohms
0-600 megohms (external supply)

☆ EIGHT DECIBEL RANGES FROM —26 to +70 DB.

☆ EIGHT OUTPUT RANGES: same as A.C. volts.

☆ HIGH VOLTAGE INSULATION RESISTANCE MEASUREMENTS TO 600 MEGOHMS.

☆ ALL FUNCTIONS at only five well-identified Push Buttons.

☆ ALL RANGES (except very high voltage and amperes) selected at only six conveniently identified Push Buttons.

☆ SILVER PLATED, heavy duty, double-wiping switching contacts.

☆ METER: Large modern 4⅝" bakelite-cased Precision rectangular meter; double jeweled D'Arsonval type; 50 microamperes full scale sensitivity. ±2% accuracy. Alnico V field magnet.

☆ WIRE WOUND AND MATCHED METALLIZED RESISTORS, BOTH OF 1% ACCURACY.

☆ OHMMETER AND CURRENT CIRCUIT accuracy closely maintained through use of stabilized ring-network.

☆ HIGH VOLTAGE CIRCUITS are highly insulated against breakdown through use of heavy duty, *sub-chassis mounted* pin jacks.

☆ CALIBRATION: All instruments individually calibrated and sealed against laboratory standards.

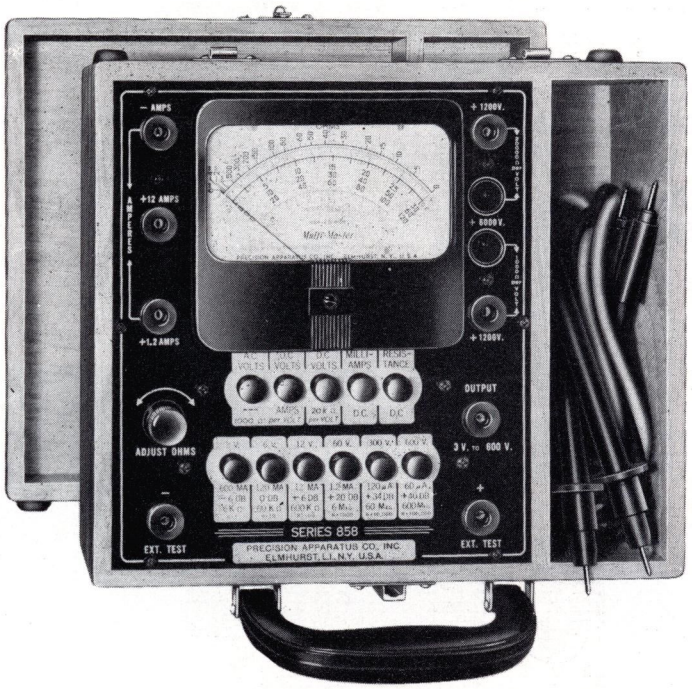
☆ HIGHEST GRADE MATERIALS and complete, plastic insulated telephone cabling employed as in all "Precision" quality test instruments.

☆ ETCHED AND ANODIZED, heavy gauge aluminum panels; resistant to moisture and wear.

PRECISION SERIES 858 MULTI-MASTER AVAILABLE IN FOLLOWING MODELS

☆ **858-P** — (illustrated) In hardwood, portable case, with tool compartment and hinged removable cover. Size 9 x 10 x 4½". Complete with operating instructions, ohmmeter batteries and high voltage test leads. Code: **Judge.**

☆ **858-L**—In modern, shallow, bakelite case with leather carrying handle. Size 7½ x 8½ x 3". (As illustrated for Series 847-L on page 13.) Complete with instructions, ohmmeter batteries and high voltage test leads. Code: **Jetty.**



The Series 858 **MULTI-MASTER** features the "Precision" Automatic Push-Button **Range** and **Function** selection system, affording the ultimate in positive operational efficiency and simplicity.

The Series 858 super-sensitive multi-range test set is specifically designed for obtaining reliable measurements in modern electronic circuits where only minute current drain of the measuring instrument can be tolerated. The 20,000 ohms per volt circuit sensitivity of the Series 858 **MULTI-MASTER** will provide accurate voltage, current and resistance measurements in television and F.M. networks; A.F.C. and A.V.C. circuits; resistance-coupled amplifier channels, grid bias and grid current in A.F. and R.F. networks and similar critical circuit measurements not otherwise obtainable unless through use of a reliable Vacuum Tube Multi-Range Meter such as Series EV-10 described on page 14. However the need of a V.T.V.M. is not always dictated nor is its understandably higher cost at all times necessary for the services required.

In addition, the **dual range sensitivity feature** doubles the utility of the Series 858, providing the equivalent of **another complete instrument** for voltage measurements at standard **1000 ohms per volt** sensitivity in direct conformance with point to point voltage reading specifications as listed by receiver manufacturers and in service manuals.

These and other innumerable features make the new "PRECISION" Series 858 **MULTI-MASTER** an invaluable requirement for television, transmitting, laboratory, photoelectric, industrial and radio service application.

PRECISION SERIES 864 DUAL RANGE SENSITIVITY • 41 RANGE AC-DC VOLT-OHM-DECIBEL-MILLIAMMETER

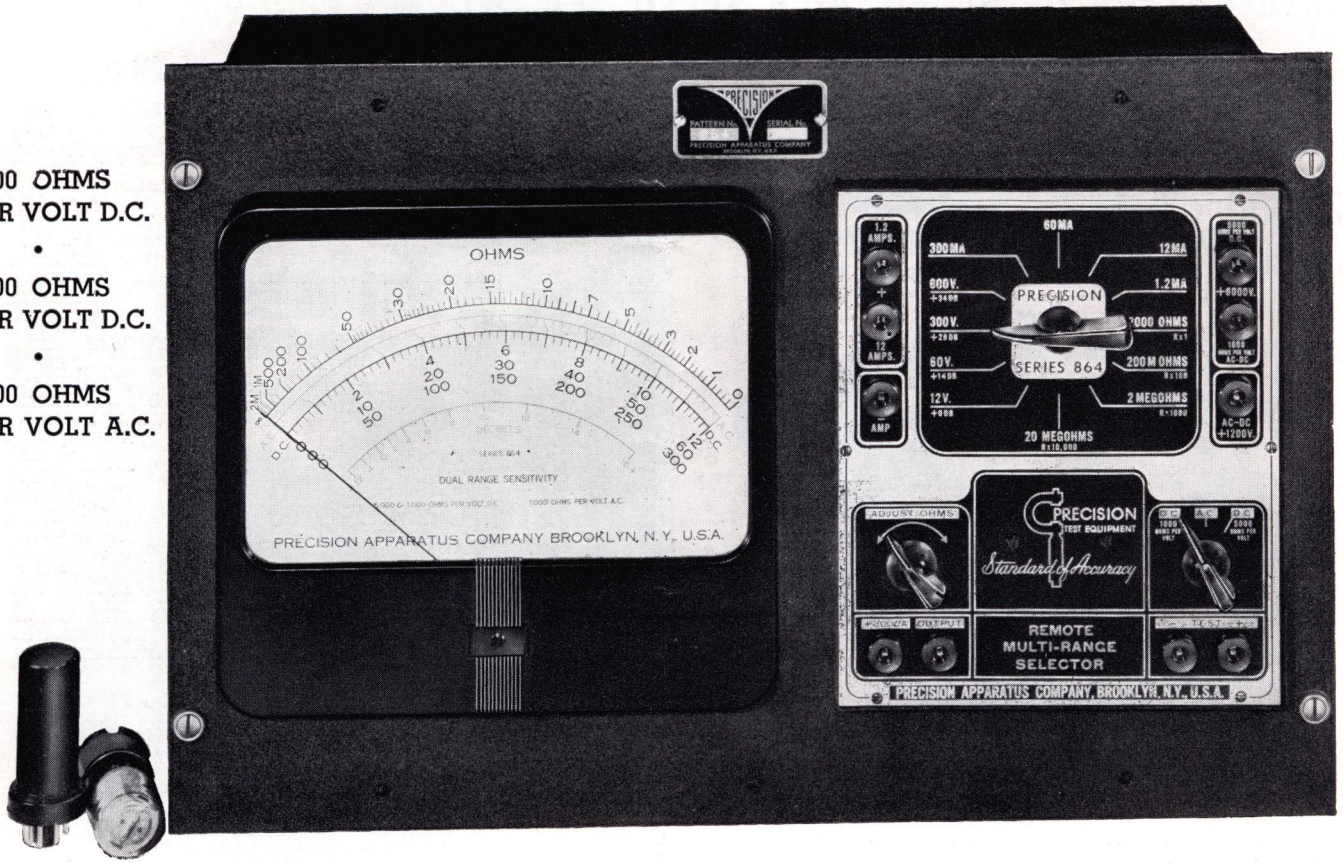
5000 OHMS PER VOLT D.C.

•

1000 OHMS PER VOLT D.C.

•

1000 OHMS PER VOLT A.C.



A panel mount, sensitive, Laboratory-Multi-Range-Tester with large 9" bakelite-cased rectangular 200 microampere meter and Remote Control Selector Unit including ranges of

6000 VOLTS A.C. and D.C. • 20 MEGOHMS • 12 AMPERES • 300 MICROAMPERES • +70 DB.

SPECIFICATIONS

☆ 6 D.C. voltage ranges at BOTH 5000 and 1000 ohms per volt:
0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ 6 A.C. voltage ranges at 1000 ohms per volt:
0-12; 0-60; 0-300; 0-600; 0-1200; 0-6000 volts.

☆ 7 D.C. current ranges:
0-300 Microamperes.
0-1.2; 0-12; 0-60; 0-300; 0-1200 Milliamperes.
0-12 Amperes.

☆ 4 Resistance Ranges: All ranges internally powered.
0-2000 ohms (15 ohms at center scale).
0-200,000 ohms. 0-2 Megohms. 0-20 Megohms.

☆ 6 Decibel Ranges from −12 to +70 DB.

☆ 6 Output Ranges: same as A.C. voltage ranges.

☆ 1% Wire Wound shunts and matched metallized multipliers employed throughout.

☆ METER: 9" Precision rectangular meter; 2% accuracy; double-jeweled D'Arsonval "bridge type" construction; 200 microamperes full scale sensitivity.

☆ CALIBRATION: All instruments are individually calibrated and sealed against laboratory standards.

☆ Color-Coded, plastic insulated Telephone type cabling utilized completely, as in all Precision instruments.

The Series 864 is a **panel-mount laboratory type of multi-range tester** designed by Precision engineers to meet the requirements for a **high sensitivity** instrument for more accurate measurements in high resistance circuits.

Although nominally priced, the Series 864 actually combines within one compact unit, **two complete Multi-range** testers—one of 5000 ohms per volt sensitivity and the other at 1000 ohms per volt. A single master rotary range selector provides speedy selection of all ranges at either sensitivity. An extra large 9", 200 MICRO-AMPERE, rectangular bakelite cased meter affords the ultimate in direct easy reading at all scales.

The separately encased Selector Unit is easily slid out from its panel compartment for remote bench operation. A seven foot flexible cord, permanently connecting meter to Remote Selector Unit, allows complete freedom of manipulation.

This instrument is an indispensable adjunct to the modern laboratory for radio service, industrial and television application, classroom demonstration and wherever operator efficiency is at a premium.

☆ **864**—(Illustrated) In standard panel mount, size 19 x 12¼" with rear dust cover 6" deep. Complete, as described, with full operating instructions, extra-high voltage test leads and batteries.

Code: **Kapok.**

PRECISION SERIES 847 DUAL-RANGE SENSITIVITY *Multi-Master*

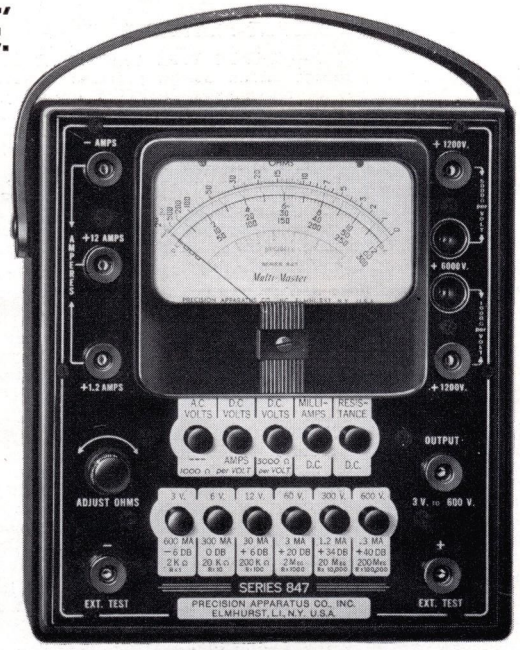
HIGH-SPEED, PUSH-BUTTON OPERATED, A.C.-D.C. MULTI-RANGE TEST SET
54 RANGES TO 6000 VOLTS, 12 AMPERES, +70 DB., 200 MEGOHMS—5000 AND 1000 OHMS PER VOLT D.C. 1000 OHMS PER VOLT A.C.

The Series 847 **MULTI-MASTER** is a rugged, moderately high sensitivity, general purpose, A.C.-D.C. test set, featuring the "Precision" Automatic Push-Button **Range** and **Function** selection system, affording a new "high" in positive, operational efficiency and simplicity.

It is ideally suited to withstand the continuous usage and handling associated with all phases of electronic maintenance and service; classroom instruction; production testing, etc. . . . Incorporates all desirable features, assuring "Precision" quality, workmanship and performance standards.

RANGE SPECIFICATIONS

- ☆ **8 D.C. VOLTAGE RANGES at BOTH 5000 and 1000 ohms per volt. 0—3—6—12—60—300—600—1200—6000 volts**
- ☆ **8 A.C. VOLTAGE and OUTPUT RANGES: 1000 ohms per volt. 0—3—6—12—60—300—600—1200—6000 volts**
- ☆ **8 D.C. CURRENT RANGES: 0—.3—1.2—3—30—300—600 M.A. 0—1.2—12 Amperes**
- ☆ **6 RESISTANCE RANGES: self-contained to 20 Megohms. 0—2000—20,000—200,000 ohms 0—2—20—200 Megohms**
- ☆ **200 MEGOHM INSULATION TEST RANGE: powered by external supply.**
- ☆ **4⅝" EASY READING METER: 200 microampere sensitivity, 2% accuracy. Rugged double-bridge construction.**
- ☆ **1% Wire-wound shunts and matched metallized multipliers.**
- ☆ **POSITIVE PUSH BUTTON Range and Function selector provides all standard measurements at only two polarized tip jacks. 6000 volt ranges at specially insulated, sub-panel mounted jacks.**

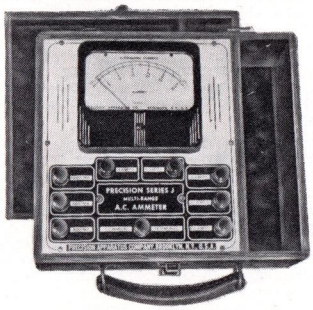


PRECISION SERIES 847 AVAILABLE IN FOLLOWING MODELS

☆ **847-L** (illustrated) — In modern, shallow, bakelite case with leather carrying handle. Size 7½ x 8½ x 3". Furnished complete with full operating instructions, ohmmeter batteries and high voltage test leads. Code: **Index.**

☆ **847-P**—In hardwood, portable case with tool compartment and hinged removable cover. Size 9 x 10 x 4½". (See Series 858-P, illustration on page 11.) Complete with all instructions, ohmmeter batteries and high voltage test leads. Code: **Ivory.**

PRECISION INDUSTRIAL CIRCUIT TESTERS AND SERIES J MULTI-RANGE A.C. AMMETER



☆ **Series J-P** (illustrated) — In hardwood carrying case, with hinged removable cover and tool compartment, size 9 x 10 x 4½". Code: **Apple.**

☆ **Series J-L**—In modern, shallow, Bakelite case (as illustrated for Series 847-L, above). Code: **Atone.**

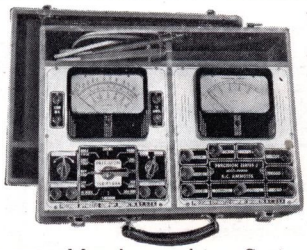
THE PRECISION SERIES "J" is a rugged, portable MULTI-RANGE A.C. AMMETER. Wide selection of ranges suited to many fields of application at power frequencies from 25 cycles. Ideally suited to radio service, motor and appliance repairs, electrical maintenance and distribution, etc.

SPECIFICATIONS: Eight alternating current ranges: 0-300-600-1200 Milliamps. 0-3-6-12-30-60 AMPS. Internal heavy duty current transformer. Rugged, brass, bakelite insulated, binding posts. Full vision, 4⅝" bakelite cased meter, 2% accuracy.

Precision A.C. - D.C. Industrial Circuit Testers

Series 844-J— 1,000 OHMS per VOLT—42 RANGES
Series 847-J— 5,000 OHMS per VOLT—62 RANGES
Series 858-J—20,000 OHMS per VOLT—62 RANGES

Ranges to 6000 volts A.C.-D.C. • 60 Amperes A.C. • 12 Amperes D.C. • 10-200-600 Megohms, etc.



The Precision line of INDUSTRIAL CIRCUIT testers provides a planned, practical solution to A.C.-D.C. circuit, maintenance and analysis **to meet your own individual sensitivity requirements.** Merely combine Series "J" with any one of Series 844 (page 10), 847 (above) or 858 (page 11) and a universal A.C.-D.C. circuit tester is instantly produced to YOUR SPECIFICATIONS AND NEEDS.

☆ **844-J** (illustrated)—Consists of Series 844 (described on page 10) and "J", in dual hardwood carrying case, with tool compartment and hinged removable cover. Sizes 11 x 15 x 4½". Complete with ohmmeter batteries and high voltage test leads. Code: **Miser.**

☆ **847-J** — Physically similar to Series 844-J described above but consists of Series 847 (described on this page) in combination with Series "J". Code: **Inter.**

☆ **858-J**—Physically similar to 844-J (illustrated) but consists of 858 (Page 11) in combination with Series J. Code: **Juror.**

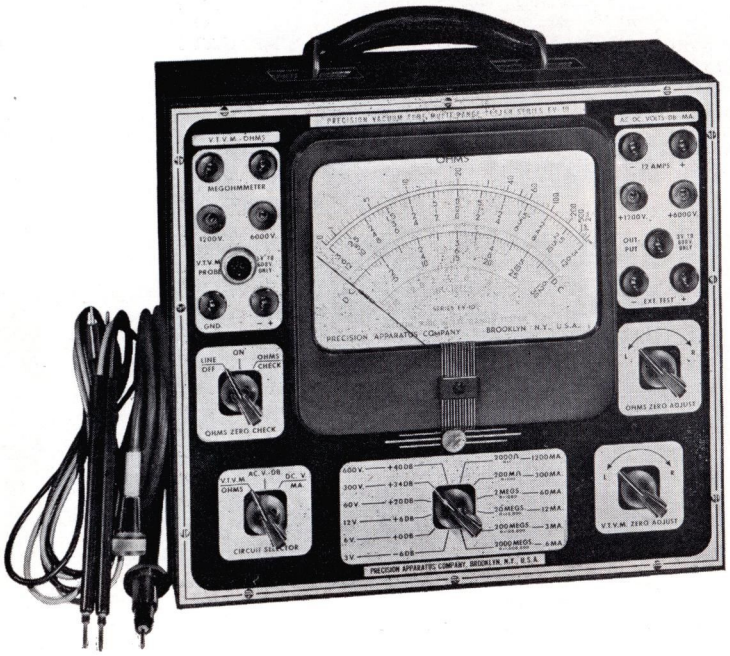
PRECISION Series EV-10 Vacuum Tube Multi-range Tester

RANGES TO 6000 VOLTS A.C. and D.C. • 2000 MEGOHMS • 12 AMPERES • 70 DB.

7" ZERO-CENTER VTVM

MEGOHMMETER • MILLIAMMETER • AMMETER

OUTPUT and DECIBEL METER • PLUS standard sensitivity 1000 OHMS PER VOLT A.C.-D.C. VOLTMETER



IMPORTANT FEATURES

☆ VOLTAGE REGULATED — BRIDGE TYPE CIRCUIT: A new departure in stabilized bridge circuit design provides a heretofore unusually high degree of direct reading VTVM accuracy, with practically complete freedom from tube variations. Utilizes one type 6C5, 6X5 and VR-150. Power supply plate voltage output remains fully constant over severe line voltage variations, eliminating annoying meter shift due to A.C. input changes.

☆ ZERO-CENTER V.T.V.M.—Provides IN ONE OPERATION, on ALL V.T.V.M. ranges, BOTH magnitude and polarity of voltage at any test point, WITHOUT reversal of test prods. Ideal for uninterrupted electronic circuit balancing, such as in F.M. discriminators, etc.

☆ SINGLE MASTER RANGE SELECTOR—Provides rapid, positive selection of all functions and ranges in combination with a simplified 3 position circuit selector.

☆ SHIELDED COAXIAL TEST PROBES—Standard and circuit isolating coaxial probes furnished as original equipment. Each probe is four feet in length, utilizing high flexibility cable. Circuit isolating probe permits direct voltage measurements without disrupting apparatus under test.

☆ DUO-BALANCED ELECTRONIC-BRIDGE OHMMETER — A new "Precision" developed feature which fully eliminates gross inaccuracies usually associated with vacuum tube ohmmeter circuit readings. BOTH ends of ohmmeter scales are independently zero adjusted, providing uniformly high accuracy throughout entire scale length. A single OHMS scale serves for ALL six resistance ranges. VTVM and OHMMETER zero settings esentially unchanged for any series of voltage or resistance range selections.

☆ EACH INSTRUMENT INDIVIDUALLY CALIBRATED via internal controls sealed against laboratory standards. Assures strict adherence to specified tolerances.

☆ Telephone cabled wiring employed completely, utilizing plastic insulated, hook-up wire. High voltage circuits are heavily insulated through use of heavy duty pin jacks, ceramic switch spacers, XXX bakelite terminal strips, etc.

☆ FULL VISION 7" RECTANGULAR METER — Employs extra large, wide faced, easy reading, bakelite cased, 7" PRECISION meter. 400 microampere D'Aronval type movement, 2% accuracy. Rugged bridge construction.

☆ 1% wire wound shunts and matched metallized multipliers employed throughout.

RANGE SPECIFICATIONS

☆ Eight Zero-Center Vacuum Tube Voltmeter Ranges—
±3, ±6, ±12, ±60, ±300, ±600, ±1200, ±6000 volts D.C.

Input Resistance—13⅓ Megohms from ±3 through ±600 volt ranges.
26⅔ Megohms on ±1200 volt range.
133⅓ Megohms on ±6000 volt range.

☆ Six Circuit Probing, Zero-Center, V.T.V.M. Ranges—
±3, ±6, ±12, ±60, ±300, ±600 volts D.C.

Special (resistance in probe) shielded coaxial test cable allows measurements to be made in sensitive circuits with minimum effect on receiver or amplifier performance.

☆ Six Wide-Range Ohmmeter-Megohmmeter Ranges: 6 volt, internal battery, powers all resistance ranges.

0-2000 ohms (20 ohms at center scale)

0-200,000 ohms (2000 ohms at center scale)

0-2 Megohms (20,000 ohms at center scale)

0-20 Megohms (200,000 ohms at center scale)

0-200 Megohms (2 Megohms at center scale)

0-2000 Megohms (20 Megohms at center scale)

Ideal selection of overlapping ranges for most all resistance measurement requirements, condenser tests, etc.

☆ Eight A.C. and Eight D.C. Voltage Ranges at 1000 ohms per volt.
0-3-6-12-60-300-600-1200-6000 volts.

A necessary feature for standard (1000 ohms per volt) sensitivity measurements in conformance with the point to point voltage reading tables furnished by receiver manufacturers and in service manuals; equally valuable and desirable for tests not requiring the extreme sensitivity of the VTVM proper as well as for audio frequency signal measurements.

☆ Seven D.C. Current Ranges—0-600 Microamperes; 0-3-12-60-300-1200 Milliamperes; 0-12 AMPERES.

☆ Eight A.C. Output Ranges—Built-in blocking condenser to 600 volts. 0-3-6-12-60-300-600-1200-6000 volts.

☆ Eight Decibel Ranges—from —26 to +70 DB. A valuable adjunct for transmission and output tests.

The Series EV-10 is a wide-range electronic measuring instrument, specifically designed and engineered to fully meet the expanding need for a compact yet complete, ultra-sensitive, modern, multi-range test set. Stressing the utmost in performance, accuracy and ease of manipulation, Series EV-10 provides the full functions and facilities of **eight distinctly individual instruments** to satisfy most all measurement requirements of the present and future electronics, communications and electrical fields. **Combining both VTVM as well as standard 1000 ohms per volt A.C.-D.C. test circuits,** Series EV-10 permits rapid, accurate check of voltage, current, and resistance conditions encountered in television, photo-electric and F.M. networks; A.V.C. and A.F.C. channels; resistance coupled amplifiers; fixed and signal grid bias of A.F. and R.F. circuits, etc., without materially disturbing actual operation and performance of the circuit under analysis.

Featuring the high "Precision" standards of performance, accuracy, workmanship and quality of materials employed, Series EV-10 will prove an invaluable electronic measuring and test standard to every progressive engineer, industrial, laboratory, school and university.

☆ SERIES RF-10 VACUUM TUBE PROBE

Available as an accessory item to Series EV-10, the RF-10 vacuum tube probe provides direct means for measurement of super-sonic, R.F. and U.H.F. voltages. Consists of flexible, rubber covered, shielded cable connecting directly to Series EV-10 panel; bakelite probe tube housing with attached low capacity probing tip; type 9002 tube probe rectifier. All operating voltages are applied through aforementioned connecting cable. No external materials required. Furnished complete, as described, with operating instructions. Code: **Probe.**

PRECISION SERIES EV-10

AVAILABLE IN FOLLOWING MODELS

☆ **EV-10-MCP** (illustrated)—In black ripple finished, heavy gauge steel case. Size 10½ x 12 x 6". Ready for operation. Complete with tubes, battery, standard and circuit-testing probes and full operating instructions. Code: **Place.**

☆ **EV-10-P**—Complete as described above but in hinged, removable covered, hardwood portable case as illustrated for Series 954-P on page 8. Code: **Phone.**

☆ **EV-10-PM** — Consists of Series EV-10 chassis mounted onto a matching steel panel and dust cover. Panel size 12¼ x 19" for standard rack mount. Appearance same as illustrated for Series 912-PM on page 9. Code: **Panel.**

PRECISION SIGNAL GENERATOR SERIES E-200-C

A THOROUGHLY MODERN MULTI-BAND SIGNAL GENERATOR FOR A.M., F.M., AND TELEVISION RECEIVER REQUIREMENTS

FEATURING "SERVICING BY SIGNAL SUBSTITUTION"

THE DYNAMIC SPEED APPROACH TO RECEIVER ALIGNMENT AND ADJUSTMENT PROBLEMS

SPECIFICATIONS

1. Frequency Coverage: 88 KC to 120 MC at turn of 6 position switch. The range, stability and accuracy of the Series E-200-C allows simple alignment of A.M., F.M. and television receivers. 30 MC on fundamental. Dial **direct reading** in 8 bands to 120 MC. No charts required.

2. Accuracy—Constancy of Calibration: MAXIMUM of 1% DEVIATION on all bands, under widely varying climatic conditions, insured by use of the "PRECISION" developed "UNIT OSCILLATOR" construction, maintaining shortest possible leads between oscillator components. Rugged ceramic spaced band switch with silver-plated contacts, ceramic suspended trimmers, zero drift silver-mica loading condensers, etc. ENTIRE "UNIT OSCILLATOR" is SINGLE POINT MOUNTED, providing positive freedom from effects of mechanical shock. The foregoing **eliminates the need to incorporate costly, useless, single frequency reference crystals.**

3. LARGE FULL VISION 6½ INCH NO-GLARE DIAL: Engine turned finish, with approximately 8 feet of easy reading deeply etched scales. Ball bearing planetary drive insures smooth tuning, free from backlash.

4. 0-1000 Point Vernier Scale and Twin Engraved Hair-Line Indicators: direct reading to one part in 1000 for critical laboratory usage. The hand-set plastacel indicators afford direct frequency readings free from parallax.

5. The Circuit—uses single-ended 6SJ7 in a highly stable E.C.O. circuit—**modulated in the buffer amplifier** by a 6C5 sine-wave audio oscillator, insuring maximum stability even at high modulation. An 80 full-wave rectifier forms the basis of a hum-free, D.C. supply.

6. 400 Cycle Sine-Wave Audio Oscillator—Independently Controlled — provides both modulation and external test signal from zero to over 50 volts. Allows DIRECT testing of Audio Power Output independent of all other stages.

7. DUAL CALIBRATED R.F. Attenuators—Separately shielded—provides direct gain measurement facilities and smooth stepless control of R.F. signal.

8. LOW LEAKAGE—Obtained through complete compartment shielding of vital components, in addition to a heavy gauge aluminum panel and steel cabinet—Power transformer electrostatically shielded—A.C. line is R.F. filtered.

9. SELF-SHIELDING COAXIAL OUTPUT CABLE and dual (LOW-HIGH) cable connectors. Separate screw cap for elimination of leakage from unused terminal.

10. Four Types of Signals—Selected at will—"Unmodulated R.F.," "400 cycle Modulated RF," "EXTERNALLY Modulated R.F." (frequency or amplitude), "400 cycle Audio Output."

11. DIRECT READING VARIABLE MODULATION — 0-100% modulation of R.F. Signal AT WILL—an original Precision feature which more than triples signal utility as against obsolete fixed modulation of only 30 or 40%. As in transmitters, only modulation of a Buffer Amplifier, allows for high level modulation without reaction on oscillator frequency.

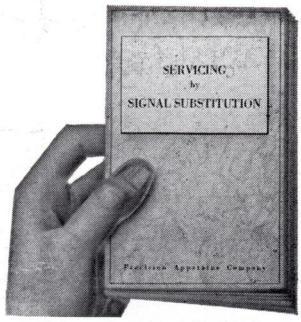
12. DIRECT READING A.V.C. SUBSTITUTION SYSTEM—The Series E-200-C fully overcomes the serious alignment troubles arising from receiver A.V.C., by supplying ITS OWN A.V.C. VOLTAGE, controllable at front of panel from 0-50 volts. Also employable for operation of portable receivers, ohmmeter circuits, etc.

13. HAND CALIBRATED—Each instrument is INDIVIDUALLY calibrated to better than 1% accuracy on all six bands.

14. FULLY LICENSED under patents of American Telephone & Telegraph Co. and Western Electric Co., Inc.

15. Not only an unsurpassed efficient multi-band Signal Generator for purposes of alignment but also SPECIFICALLY DESIGNED as the heart of "Servicing by Signal Substitution." Yet priced easily within the reach of every progressive radio service engineer.

SERVICING BY SIGNAL SUBSTITUTION*



"S-S-S" is the modern, ECONOMICAL key for the solution of your daily service problems . . . Nothing complex to learn, no extraneous equipment to purchase . . . A new systematic method of true DYNAMIC SIGNAL ANALYSIS based entirely on simple fundamentals . . . employing ONLY BASIC TEST EQUIPMENT as is normally absolutely required in the service laboratory; a reliable tube tester such as PRECISION Electronamic Series 10-12 or 912, an accurate wide-range sensitive multi-tester such as PRECISION Series 858 or EV-10 and the PRECISION Series E-200-C Signal Generator, SPECIFICALLY DESIGNED for "Servicing by Signal Substitution."

"S-S-S" provides a new high in simple rapid localization and determination of receiver troubles.

"S-S-S" is UNIVERSAL to all receiver types regardless of age, make, or design.

"S-S-S" gives unsurpassed value and service from BASIC TEST EQUIPMENT ONLY!

"S-S-S" in a single systematic dynamic attack, completely covers the entire problem with the receiver in ACTUAL OPERATION.

"S-S-S" provides complete stage-by-stage check-up, trouble shooting and alignment directly from the speaker to antenna post.

To mention only a few of the innumerable features of "S-S-S" • DIRECT R.F. AND I.F. gain measurements . . . • Finds uncoupled, dead or mistracking oscillators . . . • Quickly locates shorted or open transformer turns . . . • Picks out open by-pass and coupling condensers, etc.

This modern approach to all receiver adjustment problems, A.M. and F.M. is fully described in a bound illustrated text "Servicing by Signal Substitution." This highly valuable book is supplied with Series E-200-C at no charge.

Additional copies may be obtained from your Precision distributor or directly from Precision Apparatus Company at the very nominal cost of 40c.

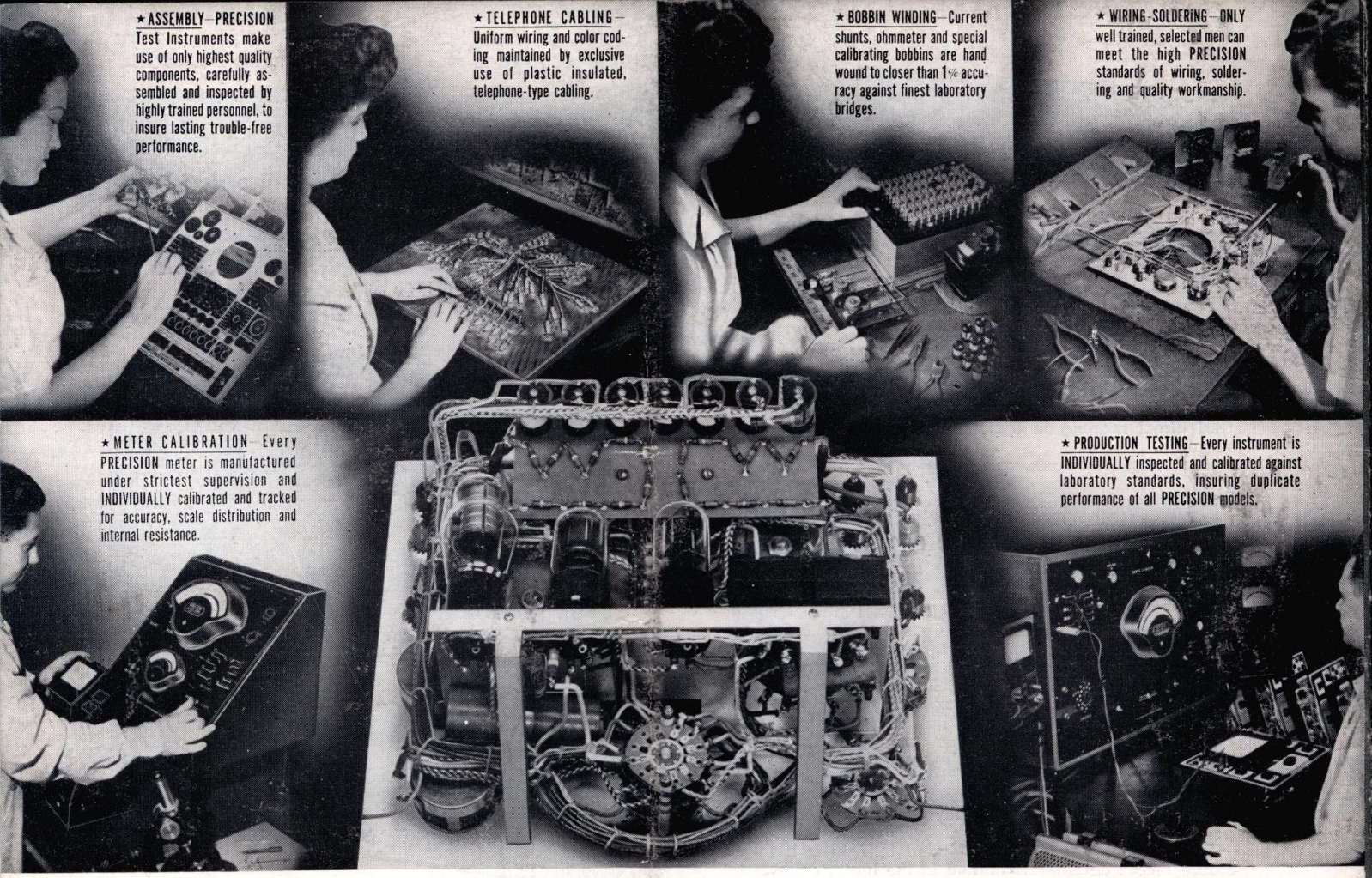
* Servicing by Signal Substitution — Copyright 1940-1947 by Precision Apparatus Company.

PRECISION SERIES E-200-C

AVAILABLE IN FOLLOWING MODELS

☆ **Series E-200-C** — (Illustrated) In black ripple finished, heavy gauge portable steel case. Size 10½ x 12 x 6". Ready for operation. Complete with tubes, coaxial output cable and FREE copy of "Servicing by Signal Substitution." Code: **Trade.**

☆ **E-200-C-PM**—Consists of Series E-200-C chassis mounted onto a matching steel panel size 12¼ x 19", for standard rack mount. General appearance same as for 912-PM on page 9. Code: **Trace.**


★ ASSEMBLY—PRECISION Test Instruments make use of only highest quality components, carefully assembled and inspected by highly trained personnel, to insure lasting trouble-free performance.
★ TELEPHONE CABLING—Uniform wiring and color coding maintained by exclusive use of plastic insulated, telephone-type cabling.
★ BOBBIN WINDING—Current shunts, ohmmeter and special calibrating bobbins are hand wound to closer than 1% accuracy against finest laboratory bridges.
★ WIRING-SOLDERING—ONLY well trained, selected men can meet the high PRECISION standards of wiring, soldering and quality workmanship.
★ METER CALIBRATION—Every PRECISION meter is manufactured under strictest supervision and INDIVIDUALLY calibrated and tracked for accuracy, scale distribution and internal resistance.
★ PRODUCTION TESTING—Every instrument is INDIVIDUALLY inspected and calibrated against laboratory standards, insuring duplicate performance of all PRECISION models.

The Inside Story

There is **NOTHING ARBITRARY, NO GUESSWORK,** behind the design, materials and workmanship which disclose **"THE INSIDE STORY"** of Precision-built instruments.

Examine the **underside** of the panel — take note of these illustrated features which are only a few of the many points revealing the infinite and painstaking care given to

"PRECISION INDIVIDUALIZED PRODUCTION"

Precision Test Equipment is guaranteed for one full year against any mechanical or electrical defects! Registration-Guarantee card accompanies every instrument.

AUTHORIZED SALES REPRESENTATIVES

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E. Kling Meuller	Georgia	Imperial Hotel, Atlanta
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P. W. Mack	Massachusetts	East Street, Granby
B. J. Fitzner Co.	Michigan	76 Adams Ave., W., Detroit
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Edwards Sales Co.	Ohio	504 Erie Bldg., Cleveland
M. A. Peckham	Pennsylvania	130 South Fairview Ave., Upper Darby
P. A. Boyd	Pennsylvania	434 Biddle Avenue, Pittsburgh
J. P. Johnson	Tennessee	3535 Dell Trail, Chattanooga
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RMA RADIO MANUFACTURERS' ASSOCIATION MEMBER

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